Mitigating Schedule Overrun in Construction Projects with AI – Driven Techniques

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Abstract- Construction receives extensive attention as schedule overruns in construction projects remain one of the most critical challenges that result in escalated expenses, disputes and dissatisfaction among clients. Construction environments are dynamic, unpredictable and uncertain, traditional project management tools are not sufficient. The advent of artificial intelligence (AI) provides new solutions to these problems. The AI supported approaches like predictive analytics, automated scheduling, risk management, and real-time monitoring offer precise prediction of project completion duration, optimal resource utilization, and potential dangers before they occur.

INTRODUCTION

The construction industry is an important pillar of economic growth but has always suffered from chronic issues with schedule delays. Construction project delays can lead to as much financial damages, contractual disputes, and harm to the parties involved. Factors responsible for schedule overruns differ from project to project but could be due to poor planning, ineffective resource allocation, unknown site environment, and outside disturbances as a result of changing weather, and regulatory limitations. After rigorous inquiries, it was discovered that traditional project management techniques may be effective for structured project environments but fail to tackle the complexity of construction projects which is often dynamic.

LITERATURE REVIEW

[1] Aibinu and Jagboro (2002) conducted a seminal study on the causes and effects of construction delays within the Nigerian construction industry. Their research, published in the *International Journal of Project Management*, identifies delays as a critical issue affecting timely project delivery, cost performance, and stakeholder satisfaction. Utilizing survey data, the study attributes delays primarily to poor project planning and inadequate contractor experience. The authors further underscore the negative ripple effects of such delays, including cost overruns, disputes, and project abandonment.

The relevance of this study lies in its early recognition of delay as a systemic issue, setting the foundation for later research focused on mitigation strategies. Although the study does not explicitly explore the role of technology, its findings highlight the potential for modern AI-driven tools to address planning inefficiencies and improve contractor selection — two root causes identified in the paper. Hence, this work serves as a valuable reference point when examining how emerging technologies can mitigate schedule overruns in construction projects.

[2]Bilal et al. (2016) provide a comprehensive review of the role of big data in the construction industry, published in *Automation in Construction*. The study outlines the current state of big data technologies and their potential to transform decision-making across the project lifecycle. The authors categorize data sources, analytics techniques, and application areas, emphasizing that despite growing data availability, the construction sector has been slow in adopting big data solutions compared to other industries.

[3] Bock and Linner (2015), in their book *Robot-Oriented Design*, present a detailed exploration of how automation and robotics can be systematically integrated into the construction process. The authors introduce a framework for robot-oriented design (ROD), which aligns project planning, design, and construction methods to support automation deployment. Their work emphasizes the need to rethink traditional construction practices by embedding robotic considerations at the early design stages to enhance efficiency, precision, and productivity.

This contribution is significant in the context of mitigating schedule overruns, as it positions robotics not merely as a tool but as a core design philosophy. By promoting standardization and modularity through ROD, the approach minimizes delays caused by human error, resource mismanagement, and site-specific complexities. Furthermore, the alignment of design and execution phases with automated systems supports more predictable timelines and streamlined workflows. The study underscores the potential for AI and robotics to serve as proactive solutions in improving schedule reliability in construction projects.

[4] Cheng, Tsai, and Liu (2020) advance the application of artificial intelligence (AI) in construction project management through their study on schedule delay prediction, published in *Automation in Construction*. The authors develop an AI-based framework that leverages historical project data to predict potential delays and support proactive decision-making. Their model combines machine learning techniques, such as support vector machines (SVM) and artificial neural networks (ANN), to identify key delay factors and assess their impact on project timelines.

The study stands out for its practical implementation of AI in mitigating schedule overrun risks. It demonstrates how predictive analytics can transition construction scheduling from reactive to preventive, allowing managers to intervene early when projects deviate from planned timelines. The research underscores the growing potential of AI not only for accurate forecasting but also for dynamic resource and schedule optimization. As such, this work directly contributes to the emerging discourse on AI-driven techniques in construction and supports their integration into mainstream project controls to enhance schedule reliability.

[5] Davis, Gajendran, and Vaughan (2018) examine the organizational and contextual factors influencing the adoption of artificial intelligence in construction project management. Published in the *Journal of Construction Engineering and Management*, the study identifies key enablers and inhibitors affecting the uptake of AI technologies, including organizational culture, leadership support, perceived value, and technological readiness. Through a mixed-methods approach, the authors reveal that despite growing awareness of AI's benefits, its adoption remains slow due to concerns about integration complexity, cost, and skill gaps.

This research contributes a critical lens to the broader discussion on AI-driven delay mitigation by highlighting the socio-technical challenges involved in implementation. While AI holds significant potential to reduce schedule overruns through enhanced planning and predictive capabilities, its effectiveness is contingent upon stakeholder buy-in and infrastructure readiness. The study underscores the importance of change management strategies, user training, and clear value demonstration in driving successful adoption. As such, it provides essential context for understanding why AI-based solutions, though technically sound, may face resistance or underutilization in real-world projects.

[6] Flyvbjerg, Holm, and Buhl (2003) investigate the prevalence and magnitude of cost overruns in transport infrastructure projects, as published in *Transport Reviews*. Analyzing a large dataset of international projects, the authors reveal that cost and schedule overruns are not anomalies but structural problems embedded in the planning and forecasting processes. While the study primarily focuses on financial performance, the implications for schedule management are profound. The research underscores that inaccuracies in early-stage planning and decision-making lead to cascading delays, a theme consistent with construction project challenges more broadly. Flyvbjerg et al.'s work highlights the need for more objective, data-driven tools in forecasting and planning — a gap that AI-driven solutions are increasingly positioned to fill. Thus, this study strengthens the argument for integrating predictive analytics and intelligent planning systems to counteract human biases and reduce schedule overruns.

[7] According to Khosrowshahi and Arayici (2012), the implementation of BIM in the UK construction industry provides a structured roadmap toward digital construction, highlighting the importance of stakeholder collaboration, data integration, and process reform. BIM facilitates real-time project monitoring, enhances visualization, and supports decision-making—features that form a foundation for AI-driven approaches.

By enabling structured and interoperable data environments, BIM acts as a crucial enabler for AI tools that require large volumes of consistent data for training and deployment. The structured data generated through BIM platforms enhances predictive accuracy and allows for integration with machine learning models for forecasting potential delays.

[8] Oesterreich and Teuteberg (2016) explore the broader implications of these trends, emphasizing

how technologies such as robotics, IoT, and cyber-physical systems are reshaping construction workflows. Their study highlights that while the adoption of digital technologies is still fragmented, it sets the groundwork for more advanced systems like AI to be effectively implemented.

Digitization enables the capture and analysis of real-time data, facilitating proactive decision-making and improved project control. These capabilities are essential in mitigating schedule overruns, as AI systems rely heavily on timely and accurate data inputs to predict delays and suggest corrective actions. The paper also identifies barriers such as organizational resistance and lack of skills, which are crucial considerations for successful AI integration.

[9] In their empirical study, Olawale and Sun (2010) identified key inhibiting factors affecting effective cost and time control, including risk and uncertainty, inaccurate estimations, and poor communication among stakeholders. Their research also highlights the limitations of conventional mitigation strategies, such as frequent progress meetings and the use of contingency allowances, which often fall short in dynamic and complex project environments.

[10] Bienvenido-Huertas et al. (2023) demonstrate how AI techniques can be combined with BIM to enhance both quantitative and qualitative analysis, particularly in the context of historical buildings. Their work underscores the power of AI in processing large datasets, detecting patterns, and providing insights that are not easily observable through traditional means.

2.METHODOLOGY

The methodology of this study is designed to explore and evaluate how AI-driven techniques are being used in the construction industry to mitigate schedule overruns. A mixed-methods approach combining both qualitative and quantitative data collection and analysis techniques has been adopted to ensure a robust and well-rounded investigation.

2.1 Existing System:

Currently, project management in the construction industry relies heavily on manual risk assessment and reactive delay management. While various project management tools and methodologies exist, there is a lack of widely accessible and effective real-time predictive systems that can accurately forecast project delays and identify critical risk factors. This gap leads to inefficiencies, cost overruns, and project failures.

2.2 Proposed System

The proposed system is an AI-integrated construction scheduling framework that addresses the limitations of conventional methods by introducing intelligent automation, real-time responsiveness, and predictive capabilities. The system is designed to assist project managers in making accurate, timely decisions to prevent schedule overruns and optimize project delivery.

2.3 Hardware Specification

Processor: Intel Core i3 or Higher

RAM: Minimum 4GB (Recommended 8GB for Better Performance)

Storage: Minimum 128GB SSD (Recommended 256GB for Better Performance)

Graphics Card: Integrated Graphics (Dedicated GPU Optional)

2.4 Software Specification

Programming Language: Python 3.8 or higher

Libraries/Frameworks:

Pandas (Data manipulation)

Scikit-learn (Machine learning)

NumPy (Numerical computing)

Matplotlib / Seaborn (Data visualization)

openpyxl / xlsxwriter (Excel output)

3.DATA FLOW DIAGRAM (DFD)

Figure 1

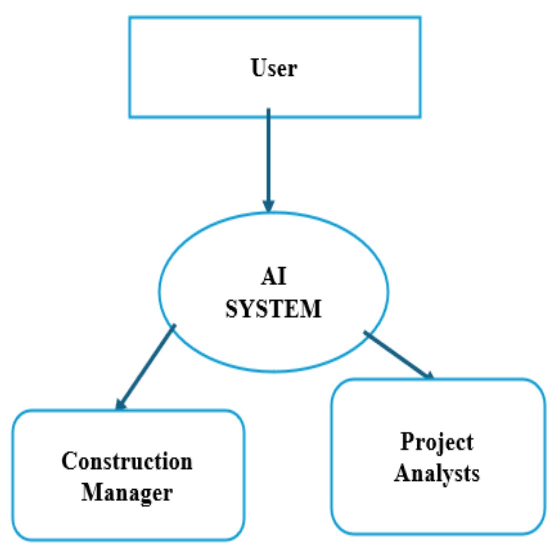
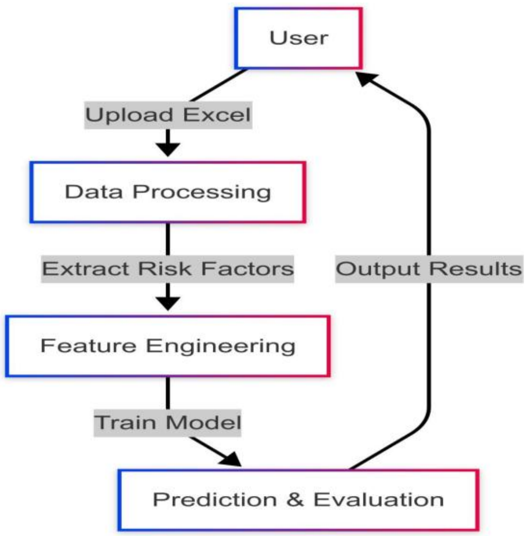


Figure 2Figure 2



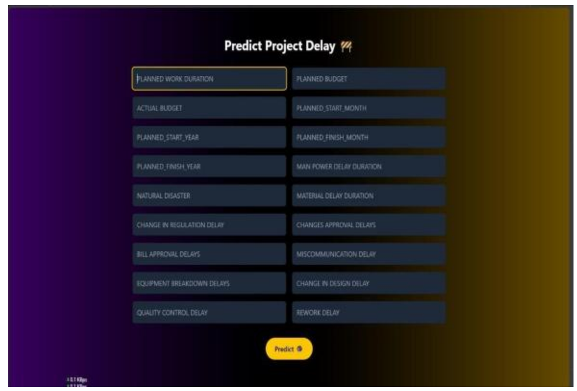
4.RESULTS AND DISCUSSION

Predictive Accuracy: respondents confirmed that AI-based forecasting tools enabled them to detect possible schedule delays well in advance.
Schedule Improvement: experienced measurable reductions in delays after incorporating AI into project planning.
Real-Time Monitoring: respondents agreed that real-time site monitoring (via AI-IoT integration) significantly improved schedule tracking and on-site decision-making.
Risk Management: 80% found AI tools highly effective in identifying and responding to risks before they escalated into delays.
Resource Optimization: 64% reported better resource distribution and reduced idle time due to AI-powered scheduling systems.

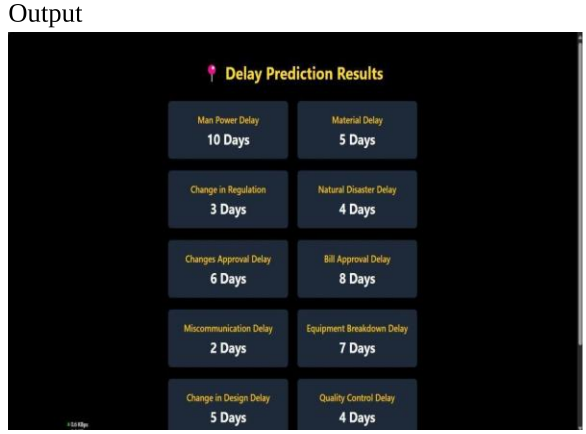
Efficiency
1. Better Planning
AI studies past project data and current conditions to plan the schedule more accurately. This reduces mistakes and helps avoid unnecessary delays.
2. Real-Time Tracking
With tools like sensors, drones, and cameras, AI tracks what's happening on the site. If something is going slower than expected, the system alerts the team immediately, so they can fix it fast.
3. Faster Decisions
Instead of waiting for reports or meetings, AI systems give live updates. Project managers can make quick decisions to keep the project moving.
4. Smarter Use of Workers and Machines
AI suggests how to assign tasks to workers and use machines more effectively, so there is less idle time and no overwork.

Sample Screen :
Figure 3

User Interface



Output



5.CONCLUSION

In conclusion, the culmination of this project, the "Construction Project Delay Prediction and Risk Factor Analysis" system, represents a significant stride towards enhancing project management practices within the construction industry. By integrating data-driven predictive modeling, quantitative risk analysis, and real-time insights, this system successfully demonstrates the potential to transform project management from a reactive to a proactive approach. The system's core functionality, built upon the robustness of Python and the analytical power of Pandas and Scikit-learn, enables the seamless processing and analysis of project data.

effectiveness in real-world scenarios, highlighting its potential to empower project managers with enhanced decision-making capabilities.

REFERENCE

[1] Aibinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*, *20*(8), 593-599.

[2] Bilal, M., Oyedele, L. O., Qadir, J., Munir, K., Ajayi, A. O., Akinade, O. O., ... & Pasha, M. (2016). Big Data in the construction industry: A review of present status, opportunities, and future trends. *Automation in Construction*, *72*, 15-28.

[3] Bock, T., & Linner, T. (2015). *Robot-oriented design: Design and management tools for the deployment of automation and robotics in construction*. Cambridge University Press.

[4] Cheng, M. Y., Tsai, H. C., & Liu, Y. W. (2020). Artificial intelligence-based schedule delay prediction and management for construction projects. *Automation in Construction, 110*, 103-116.

[5] Davis, K., Gajendran, T., & Vaughan, J. (2018). Factors influencing adoption of AI in construction project management. *Journal of Construction Engineering and Management*, *144*(8), 05018007.

[6] Flyvbjerg, B., Holm, M. S., & Buhl, S. (2003). How common and how large are cost overruns in transport infrastructure projects? *Transport Reviews, 23*(1), 71-88.

[7] Khosrowshahi, F., & Arayici, Y. (2012). Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, *19*(6), 610-635.

[8] Oesterreich, T. D., & Teuteberg, F. (2016). Understanding the implications of digitization and automation in the construction industry. *Computers in Industry*, *83*, 121-139.

[9] Olawale, Y., & Sun, M. (2010). Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, *28*(5), 509-526.

[10] Integrating Artificial Intelligence Approaches for Quantitative and Qualitative Analysis in H-BIM" Authors: David Bienvenido-Huertas, Blanca Tejedor, Manuel J. Carretero-Ayuso, Carlos E. Rodríguez Jiménez, Marta Torres-González